MAXIMISING POWER IN OPTICAL COMMUNICATIONS NETWORKS

This invention relates to optical communications networks, and in particular to maximising power available to launch signals onto optical communications networks.

The design of photonics systems requires that the OSNR (optical signal to noise ratio) is above a given minimum value over the longest path under the worst case conditions.

Optical communication systems, such as wavelength division multiplex (WDM) systems typically use optical amplifiers in the signal path. A limiting feature of optical amplifiers is the power available. This may be due to safety constraints or cost. The maximum output power of an amplifier is conventionally divided equally amongst all the channels being transmitted.

However, higher bit rate channels such as 10Gbit/s require a better OSNR than lower bit rate channels such as 2.5Gbit/s channels. It has been proposed (EP-A-0 924 888) to adjust the optical power in individual channels by measuring optical power along the transmission path in use. However, the processing overload for this is relatively high.

Also, it has been proposed (WO 02/09299) to compensate for wavelength dependent gain and noise profiles by pre-emphasising individual channels of a WDM by values obtained by measuring the OSNR of the undistorted channels.

The invention aims to maximise the power available to signals requiring a higher bandwidth and or greater path length. Broadly, this is achieved by dividing available output power amongst the channels according to their individual bandwidth/distance requirements.

More specifically, there is provided a method of controlling signal launch power in an optical communications network, comprising pre-distorting the launch power in accordance with known values of at least one of bandwidth and expected noise on the signal path.

The invention also provides apparatus for controlling signal launch power in an optical communications network, comprising a launcher for launching a signal onto the network, and means for pre-distorting the launch power in accordance with known values of at least one of bandwidth and expected noise on the signal path.

This has the advantage that launch power can be conserved and redirected to maximise the bandwidths that can be transmitted and to increase the path lengths over which signals can be transmitted, without incurring a processing overload due to making measurements.

Preferably, the optical communications network carries an n channel signal multiplex, and a plurality of signals are launched from a network node.

Preferred embodiments have the advantage that for a given launch power available at an add/drop node, the power can be distributed amongst the channels in accordance with the requirements of each channel. This again can increase the bandwidth that can be sent and increase the transmission distance that can be achieved.

The noise is generated at the optical amplifiers, and the expected noise can be determined knowing the route of the signal, that is, the number and type of optical amplifiers the signal will pass through in the network. This will be indicative of the OSNR. The known values may be provided by management systems of the optical communication systems, for example, by the network manager, or by a shelf manager. Equally, the known values may be provided by data passed along a supervisory channel.

In a preferred embodiment, the pre-distorted signals are passed though an optical amplifier, and the launch power is pre-distorted using a comparator. A separate comparator is provided for each channel of the optical multiplex, a suitable de-multiplexer being provided at the output of the optical amplifier. One input to the comparator is a signal, preferably electrical, derived from the output of the optical amplifier for any particular channel, while the other is representative of the known values of at least one of bandwidth and expected noise on the signal path through the network for that channel. The output of the comparator controls the launch power of the signal for that channel into the optical amplifier, for example, by means of a variable optical attenuator for a through channel, or a transponder for an added channel.

An embodiment of the invention will now be described, by way of example only, and with reference to the accompanying drawings, in which:

Figure 1 is a schematic diagram illustrating the principle of the invention;

Figure 2 is a schematic diagram showing how launch power can be adjusted according to the connection path; and

Figure 3 shows the invention applied to an optical ring network.

The embodiments described divide the available output power amongst the channels according to individual bandwidth requirements. The higher the bit rate, the higher the power level allocated to that channel ensuring that all channels are launched such that they are received with adequate OSNR.

The power output for a given channel can also be controlled according to the number and type of network elements the signal is to pass through.

Referring to Figure 1, an optical amplifier 10 amplifies a WDM optical signal on a fibre 11. The output is split at a coupler 12 providing an output signal path 13 and a

CLAIMS

1. A method of controlling signal launch power in an optical communications network, comprising pre-distorting the launch power in accordance with known values of at least one of bandwidth and expected noise on the signal path.
2. A method as claimed in claim 1, wherein the known values are provided by management systems of the optical communication network.
3. A method as claimed in claim 2, wherein the known values are provided by a network and connectivity information unit.
4. A method as claimed in claim 2, wherein the known values are supplied by a supervisory channel.
5. A method as claimed in any one of claims 1 to 4, wherein the pre-distorted signals are passed through an optical amplifier.
6. A method as claimed in claim 5, wherein the signal launch power is pre-distorted using a comparator, which compares a signal derived from the output of the optical amplifier with a reference signal dependent on the known values of at least one of bandwidth and expected noise.
7. A method as claimed in any one of claims 1 to 6, in which the expected noise on the signal path is derived from a knowledge of the number and type of optical amplifiers the signal will pass through in the optical communications network.
8. A method as claimed in any one of claims 1 to 7, in which the optical communications network carries an n channel multiplex, the launch powers of all of which through an optical amplifier are pre-distorted.

9. A method as claimed in any one of claims 1 to 8, in which the launch power is pre-distorted to increase the signal level of signals having a higher bandwidth compared to those having a lower bandwidth.

10. A method as claimed in any one of claims 1 to 9, in which the launch power is pre-distorted to increase the signal level of signals having a higher expected noise through the network compared to those having a lower expected noise.

11. Apparatus for controlling signal launch power in an optical communications network, comprising a launcher for launching a signal onto the network, and means for pre-distorting the launch power in accordance with known values of at least one of bandwidth and expected noise on the signal path.

12. Apparatus as claimed in claim 11, wherein the known values are provided in use by management systems of the optical communication network.

13. Apparatus as claimed in claim 12, wherein the known values are provided by a network and connectivity information unit.

14. Apparatus as claimed in claim 12, wherein the known values are supplied by a supervisory channel.

15. Apparatus as claimed in any one of claims 11 to 14, including an optical amplifier through which the pre-distorted signals are passed in use.

16. Apparatus as claimed in claim 15, wherein the pre-distorting means includes a comparator, arranged to compare a signal derived from the output of the optical amplifier with a reference signal dependent on the known values of at least one of bandwidth and expected noise.

17. Apparatus as claimed in any one of claims 11 to 16, in which the number and type of optical amplifiers the signal will pass through in the optical communications network is used to derive the expected noise on the signal path.

18. Apparatus as claimed in any one of claims 11 to 17, in which the optical communications network is adapted to carry an n channel multiplex, the launch powers of all of which through an optical amplifier are pre-distorted in use.

19. Apparatus as claimed in any one of claims 11 to 18, in which the pre-distorting means is arranged to increase the signal level of signals having a higher bandwidth compared to those having a lower bandwidth.

20. Apparatus as claimed in any one of claims 11 to 19, in which the pre-distorting means is arranged to increase the signal level of signals having a higher expected noise through the network compared to those having a lower expected noise.

21. Apparatus as claimed in any one of claims 11 to 20, in which the apparatus is an add/drop node.